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Amendments to the Claims

Please cancel Claims 1-3 and 7-14 without prejudice to or disclaimer of the subject matter recited therein.

Please amend Claims 4 and 5, and add new Claims 15 and 16 to read as follows.

Claims 1-3 (cancelled)

4. (Currently amended) The electroluminescence device according to Claim ~~3~~ 15 or 16, wherein the luminescent organic layer and the carrier transporting layer comprising ~~a~~ the conductive liquid crystal have been formed by vacuum deposition.

5. (Currently amended) The electroluminescence device according to Claim ~~3~~ 15 or 16, wherein the substantially parallel alignment of the π-electron structure plane of the conductive liquid crystal in the carrier transporting layer has been achieved by a heat treatment of the device.

6. (Previously presented) The electroluminescence device according to Claim 4, wherein the luminescent organic layer is in an amorphous state.

Claims 7-14 (cancelled)

15. (New) An organic electroluminescence device comprising:

a pair of oppositely spaced electrodes; and

a carrier transporting layer and a luminescent organic layer disposed in lamination between the electrodes so that the carrier transporting layer is disposed in contact with one of the electrodes,

wherein the carrier transporting layer comprises a conductive liquid crystal having a π-electron resonance structure in its molecule, and the π-electron resonance structure plane of the conductive liquid crystal in the carrier transporting layer is aligned substantially parallel to surfaces of the electrodes,

wherein the conductive liquid crystal is a discotic liquid crystal, and

wherein the conductive liquid crystal is in a discotic disordered phase or a liquid crystal phase having a lower order than the discotic disordered phase.

16. (New) An organic electroluminescence device comprising:

a pair of oppositely spaced electrodes; and

a carrier transporting layer and a luminescent organic layer disposed in lamination between the electrodes so that the carrier transporting layer is disposed in contact with one of the electrodes,

wherein the carrier transporting layer comprises a conductive liquid crystal having a π-electron resonance structure in its molecule, and the π-electron resonance structure plane of the conductive liquid crystal in the carrier transporting layer is aligned substantially parallel to surfaces of the electrodes,

wherein the conductive liquid crystal is a smectic liquid crystal, and

wherein the conductive liquid crystal is in a smectic E phase or a liquid crystal phase having a lower order than the smectic E phase.

The device of Comparative Example 1 did not exhibit a remarkable increase in current density unlike the device of Example 1 when heated to 90 ^{O}C. This is presumably because HBOT assumes discotic ordered phase at 90 ^{O}C and does not have discotic disordered phase. As a result of observation of actual alignment state in a device, HHOT assumes a homeotropic alignment state wherein the director is aligned in agreement with a normal to the substrate as mentioned above, whereas HBOT does not readily assume a homeotropic alignment state but assumes a substantially random alignment state.

On the other hand, the device of Example 2 caused a remarkable increase in current density similarly as in Example 1 when heated to 65 ^{O}C. This may be attributable to an improvement in carrier injection efficiency at the boundary between the ITO film and the HHOT layer due to alignment of HHOT.

In the device of Example 2, the increase in current density was observed in some cases even at a temperature somewhat below the phase transition temperature (65 ^{O}C) where the liquid crystal portion was not considered to completely form a homeotropic alignment. This may be attributable to a feature that a microscopic alignment change favoring the improvement in carrier injection at the electrode boundary can be relatively easily caused in discotic

disordered phase.

On the other hand, the device of Comparative Example 2 including a 20 nm-thick CuPc layer inserted between the ITO electrode and the HHOT layer exhibited a remarkably larger current density of 1136 $\mu A/cm^2$. This is presumably because CuPc has a HOMO of 4.09 eV lower than an HHOT's HOMO of 5.13 eV and provided a reduced energy barrier of 0.09 eV reduced from 0.53 eV relative to the ITO's work function of 4.60 eV.

However, the device of Comparative Example 2 did not cause a substantial increase in current density even when heated to 65 - 68 ^{o}C. This is presumably because CuPc have no liquid crystal phase is a temperature range of 65 - 68 ^{o}C, and a carrier injection efficiency improvement by re-alignment of π-electron resonance plane as in the device of Example 1 cannot be expected.

Incidentally, in a device having a layer structure of ITO/HHOT/CuPc/Alq3/AlLi including a layer order reverse from ITO/CuPc/HHOT ... in the device of Comparative Example 2, an increase in current density accompanying a temperature increase was observed similarly as in Example 1. Accordingly, the current density increase due to a temperature increase may be attributable to an improvement in carrier injection efficiency at the ITO/HHOT boundary.

(Example 3)

To supplement, the discotic liquid crystal phases may be classified into discotic nematic phase and discotic columnar phase, and the discotic columnar phase is further divided into discotic disordered phase and discotic ordered phase which has a higher order than the discotic disordered phase.

A higher mobility is exhibited by a liquid crystal having discotic ordered phase, but in view of a carrier injection performance from an electrode surface, a liquid crystal having discotic disordered phase can exhibit a better performance because of its better alignability of π-electron resonance plane parallel to the electrode surface according to the present invention, thus being preferably used to constitute a carrier transporting layer according to the present invention.

Incidentally, in the case of passing across a layer of organic compound sandwiched between a pair of electrodes, the carrier injection is effected by a tunnel current or a Schottky current depending on an energy barrier at the injection boundary. And, if the injection barrier is sufficiently low and the carrier is sufficiently injected, the current is flowed as a spatial charge controlling current proportional to the mobility. Accordingly, in order to perform an effective current flow, it is preferred to improve the injection performance at a proximity to the boundary